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Functional adaptation of mercuric reductases from the deep brine environment of Atlantis II in the Red Sea to high temperature

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The lower convective layer (LCL) of the Atlantis II brine pool of the Red Sea is a unique environment characterized by high salinity of 4.4 Molar, temperature of 68 °C and very high concentrations of heavy metals. Mercuric reductase enzymes functional in such extreme conditions could be used in the environmental detoxification of mercurial poisoning. This would be of use in the Egyptian Gold mines, where mercury used in the extraction process imposes a serious ecological hazard. We constructed an environmental Atlantis II mercuric reductase library, where we have identified two classes of mercuric reductases. One is the halophilic/thermostable *merA*. It is designated ATII-LCL-*H*. It retains 50% of its activity after 10 minutes incubation at 75 °C. The other is a non-halophilic/thermostable *merA* designated as ATII-LCL-*NH*. It retains 61% of its activity at 65 oC. The ATII-LCL-*H merA* has two characteristic signature boxes and a short motif composed of 4 aspartic acids ($4D_{414-417}$). In order to understand how two enzymes from the same environment have evolved to withstand heat, we mutated the isoform ATII-LCL-*NH*. Substitution of 2D at positions 415/416 enhanced the thermal stability while other mutants did the opposite effect. The 2D mutant retains 88.6% of its activity at 65 °C. Three-dimensional structure prediction revealed newly formed salt-bridges and H-bonds in the 2D mutant as compared to the parent molecule.

Biography

Mohamad Maged Galal was graduated from the Faculty of Pharmacy, Cairo University in 2007. He has completed his MSc in Biotechnology in 2011 and currently pursuing PhD from the American University in Cairo, Egypt.

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